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21 February 1957

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SUBJECT: Contract [ ] (LTA-Balloon Concept Study)

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Dear [ ]

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This is the third of a series of informal letter reports concerning the progress under Contract [ ] for the period 1 January to 15 February 1957.

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We have been pursuing in this interval one of the areas indicated in the last informal report. This deals with the mechanical properties of pressurized bodies. I believe that the extension and enlargement of this work may extend the current understanding of all lighter-than-air vehicles and could ultimately dictate many of the important design parameters.

Up to this time we have been considering bodies of uniform cross section for simplicity. An example of this is a pressurized cylinder. It can be shown that the change of potential energy within any such system is:

$$APE = -dV(p-p_0) + (pdV + Vdp) \ln p/p_0$$

where  $p$  and  $V$  are the pressure and volume of the body and  $p_0$  is the ambient pressure. Using this expression, the compressional and bending characteristics of bodies of several different cross sections have been determined. It is interesting to note that each of these solutions has the same general result for a particular type of bending. Using these general results, we have found that any particular pressure beam of uniform cross section has a specified bending strength linearly dependent on its cross sectional area, the maximum thickness in the direction of the applied force, the pressure differential and an inverse depending on its length. Calculating the bending strength of, for example, a cylindrical nylon beam which is 50 feet in length, 2-3/4 feet in diameter, and weighing 15 pounds, it is found that the beam could support at least 400 pounds at its mid point when supported at each end. This remarkable demonstration of strength to weight can be verified by laboratory tests.

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We are now attempting to calculate the mechanical properties of beams which have non-uniform cross sections such as exist in streamlined shapes or even balloon shapes. It can be seen that this work is vital to the clear understanding of what bending moments may be applied to not only the streamlined body but also to its inflatable control surfaces.

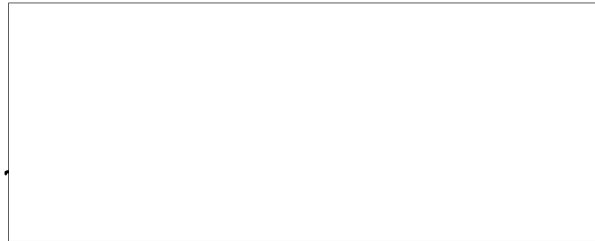
We have also begun a preliminary analysis of the requirements to provide stability to this type of vehicle. Here again, some of the literature which we have surveyed contains insufficient information to adequately specify what type of size of control surfaces is necessary for a given case.

The materials testing laboratory has completed an extensive survey of various barrier materials, including several plastic films, papers and some cloths. This report is of a fairly extensive nature and will not be discussed here.

In order to summarize our work up to this time, a quarterly report will be prepared during the next six weeks. This report shall include all work up to this time and will specify the areas of study which require additional research.

As of 20 January 1957, 70 per cent of the project funds remained.

Sincerely yours,



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Geophysics Section

RLS:mm